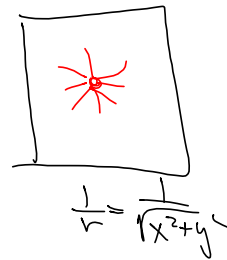
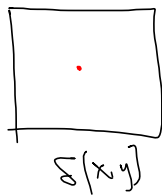
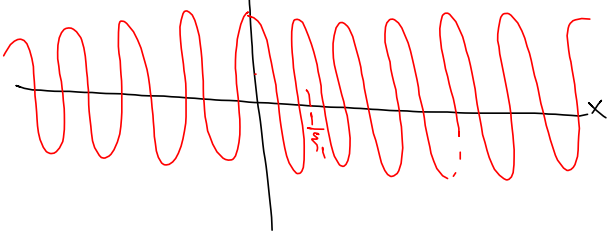
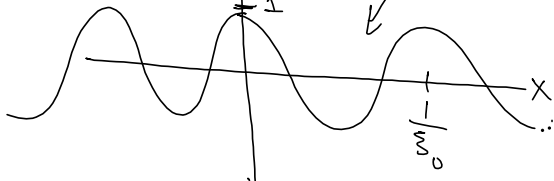


DIP
CT, MRI



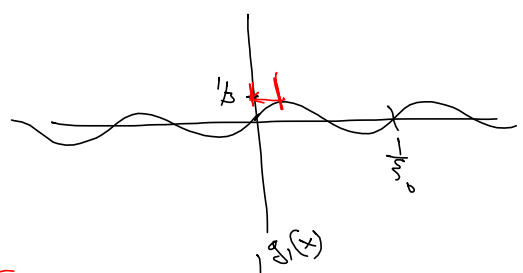
LSI $f(x) * h(x) = g(x)$
 $\overline{F(\xi)} \cdot \overline{H(\xi)} = \overline{G(\xi)}$

$|F(\xi)| e^{i\phi_F(\xi)}$
 $f(x) \uparrow \cos(2\pi\xi_0 x) \rightarrow +0$



$\frac{1}{2} \sin(2\pi\xi_0 x)$
 $\left(\frac{1}{2}\right) \cos\left(2\pi\xi_0 x - \frac{\pi}{2}\right)$

$g_0(x)$



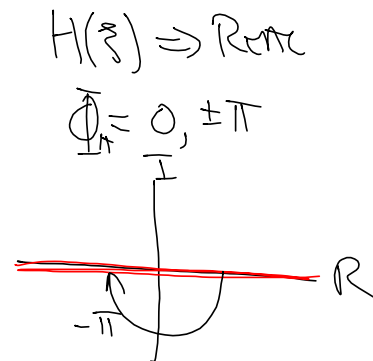
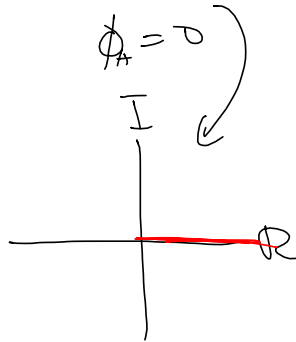
$$H(\xi) = |H(\xi)| e^{i\phi_H(\xi)}$$

$$G(\xi) = |F(\xi)| |H(\xi)| e^{i(\phi_F(\xi) + \phi_H(\xi))}$$

"MAGNITUDE" ; $\phi_H(\xi) = 0$ $H(\xi) = \underbrace{|H(\xi)|}_{\text{REAL, } \geq 0} e^{i \cdot 0}$

PHASE

BOTH



COMPLEMENTARY

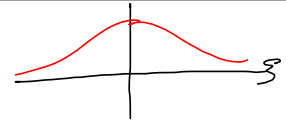
LOWPASS
 ↘ HIGHPASS =

$$H_{LP}(s)$$

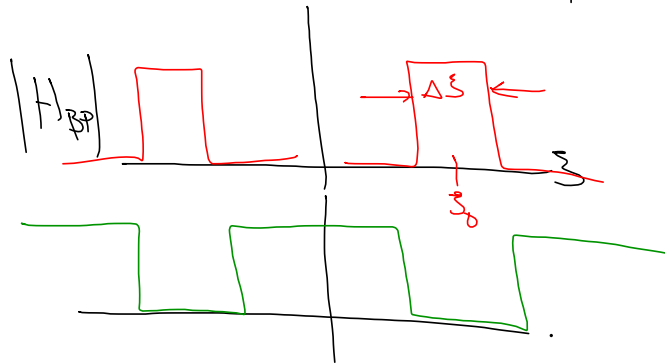
$$1 - H_{LP}(s) = H_{HP}(s)$$

BANDPASS
 BANDSTOP

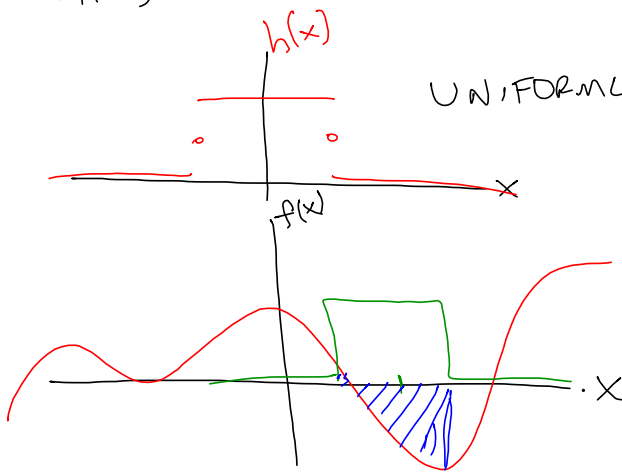
$$\begin{cases} |H_{HP}(0)| = 0 \\ |H_{HP}(\pm\infty)| \neq 0 \end{cases}$$



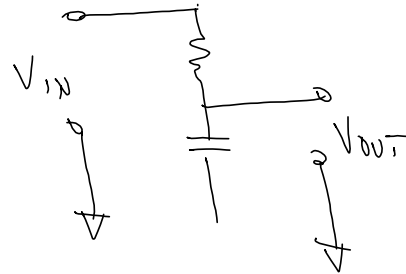
$$\begin{aligned} |H_{LP}(0)| &\neq 0 \\ &= 1 \\ H_{LP}(\pm\infty) &= 0 \end{aligned}$$



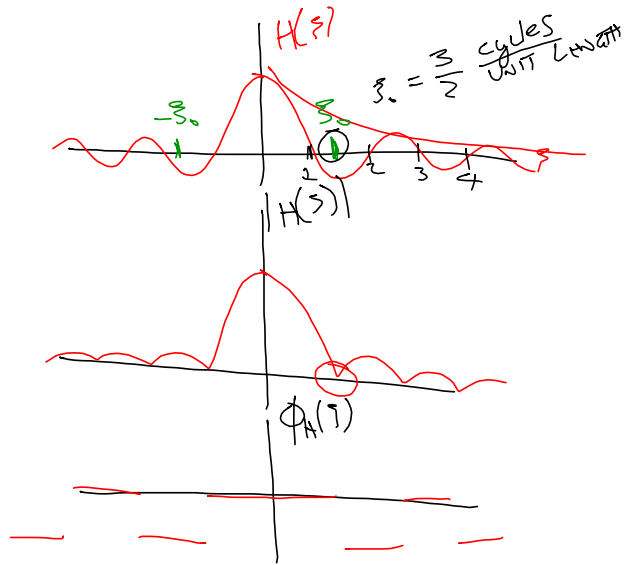
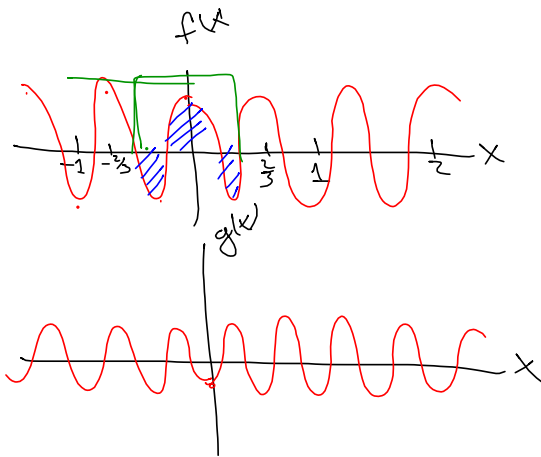
$$h(x) = \text{RECT}(x)$$



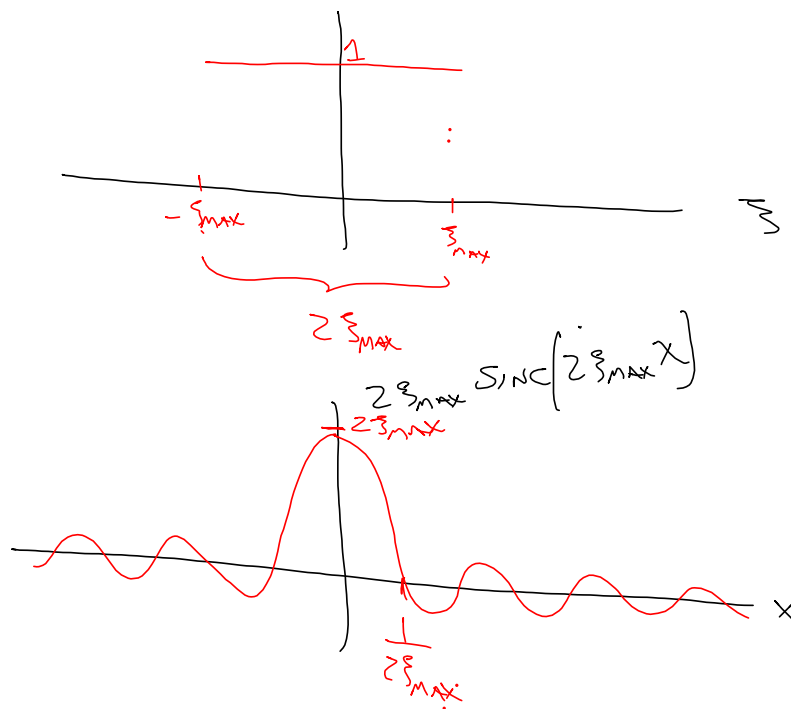
UNIFORMLY WEIGHTED AVERAGER



$$h(x) = \text{Rect}(x) \rightarrow H(\xi) = \text{sinc}\left(\frac{\xi}{2}\right)$$

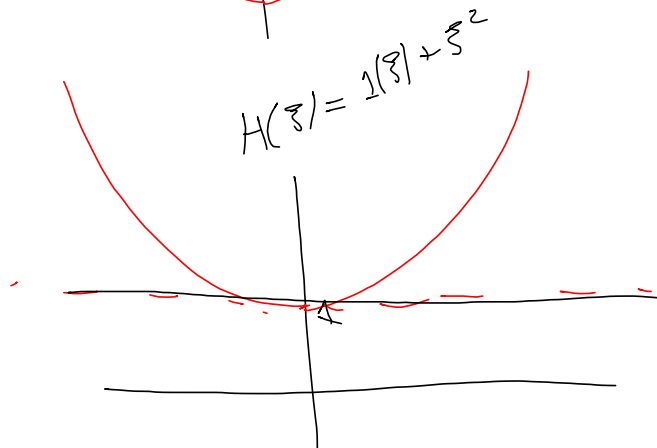
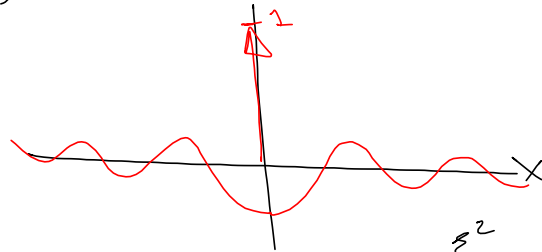
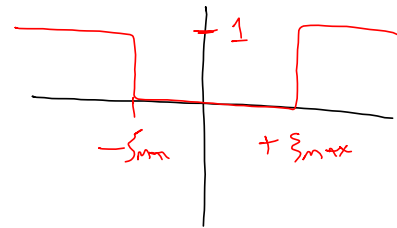


IDEAL LPF $H(\xi) = \text{RECT}\left[\frac{\xi}{2\xi_{\text{MAX}}}\right]$

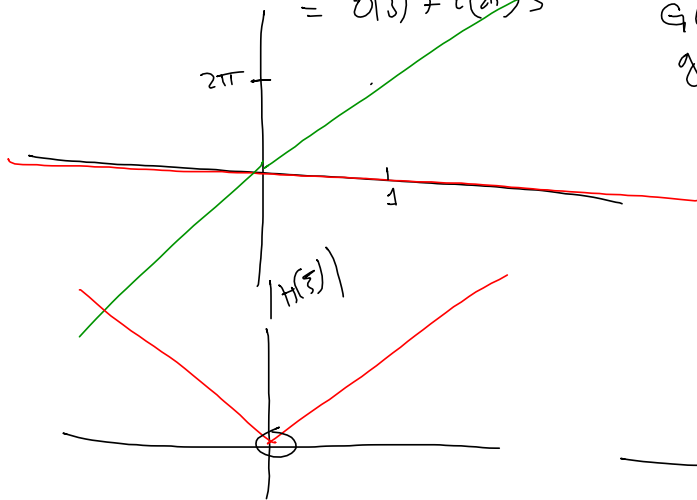


$$H_{HP}(z) = \underset{\uparrow}{1} - H_{LP}(z) ; 1 - \text{Re}\left(\frac{z}{2z_{max}}\right)$$

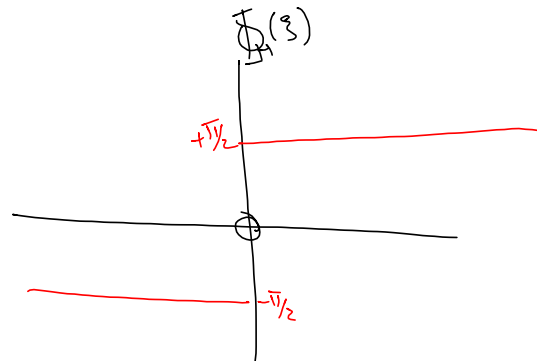
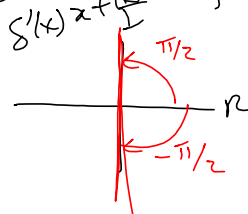
$$h_{HP}(x) = \delta(x) - h_{LP}(x)$$



$H(s)$ — Real
 $H(s)$ — Imag
 $= 0(s) + i(2\pi)s$



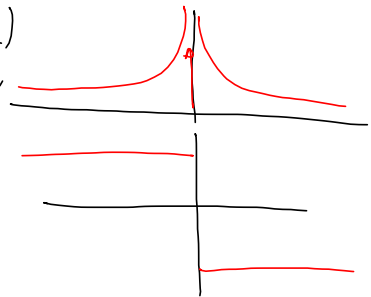
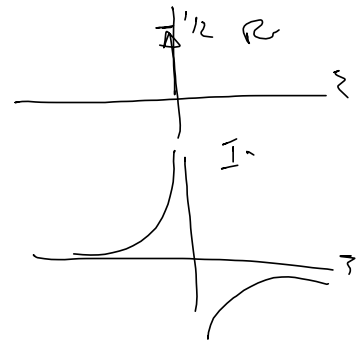
$H(s) = +i2\pi s$
 $G(s) = i2\pi s \cdot F(s) = f'(x)$
 $g(x) = \delta'(x)$

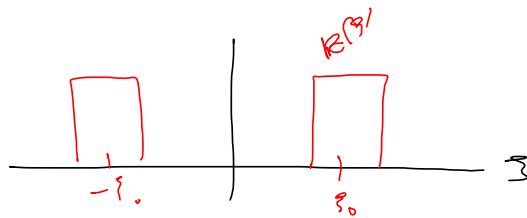


$$\begin{array}{ccc}
 f(x) & h(x) & g(x) \\
 f(x) & \int_{-\infty}^x \delta(\alpha) d\alpha = \text{STEP}(x) & f(x) * \text{STEP}(x) = \int_{-\infty}^x f(\alpha) d\alpha \\
 f(x) & \delta(x) & f(x) \\
 & \delta'(x) & f'(x)
 \end{array}$$

$$\begin{aligned}
 g(x) &= f(x) * \text{STEP}(x) \\
 G(\zeta) &= F(\zeta) \cdot \left[\frac{1}{i} \delta(\zeta) + \frac{1}{\zeta} \left(\frac{1}{i\pi\zeta} \right) \right]
 \end{aligned}$$

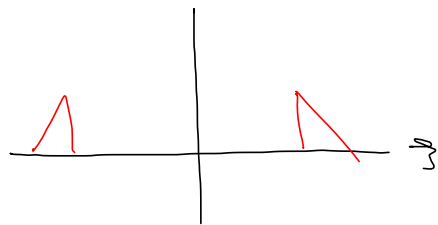
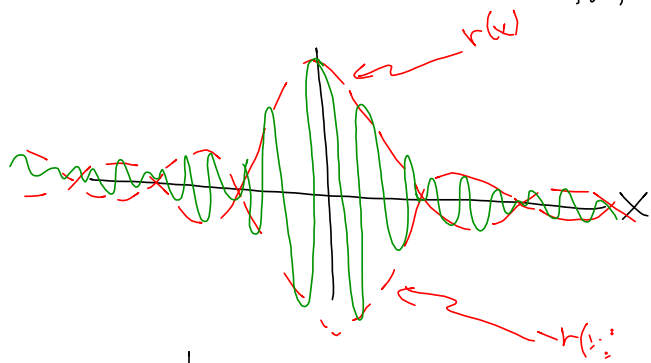
$$\text{STEP}(x) = \underbrace{\frac{1}{2} \cdot 1(x)}_{\text{even}} + \underbrace{\frac{1}{2} \text{SIGN}(x)}_{\text{odd}}$$



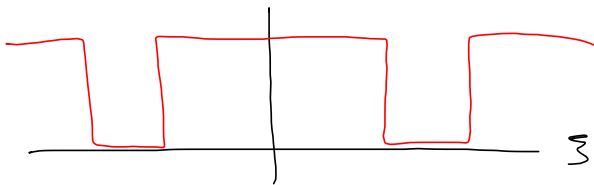


$$H(\xi) = R(\xi) * (\delta(\xi + \xi_0) + \delta(\xi - \xi_0))$$

$$h(x) = r(x) \cdot 2 \cos(2\pi \xi_0 x)$$

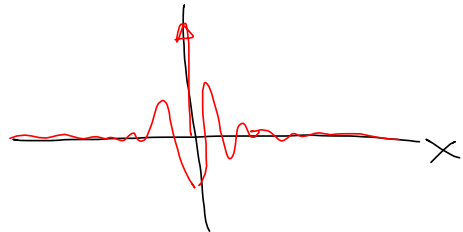


$$R(\xi) * (\delta(\xi + \xi_0) + \delta(\xi - \xi_0))$$



$$H(s) = 1 - H_{BP}(s)$$

$$h(x) = \delta(x) - h_{BP}(x)$$



PHASE FILTERS

$$H(\omega) = |H(\omega)| e^{i\phi_H(\omega)}$$

$$= e^{i\pi(\omega(\omega))}$$

